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THE RUSTS OCCURRING ON THE GENUS FRITILLARIA

Charles C. Rees

The Fritillaria rusts of Europe and America furnish an interesting problem for taxonomic study. In the absence of inflorescence the resemblance of the genera Fritillaria and Lilium, upon which occurs *Uromyces Lilii* (Link) Fckl., as interpreted by European authors, is striking. This host resemblance, coupled with the fact that the rusts infecting them present a somewhat similar gross appearance, has resulted in considerable confusion in the naming of many collections.

Evidence derived from a study of types and other material of the Opsis-Uromyces species on these hosts in the Arthur herbarium has led to the conclusion that the species on Fritillaria in Europe is morphologically quite separate and distinct from the rust with the same life-cycle on Lilium in that region and from the American form on the same host as well. The writer is therefore inclined to recognize as a valid species, *Uromyces Fritillariae* (Schlechtd.) Thüm., to which all of the European specimens on Fritillaria, seen by the writer, should be referred. All of the Uromyces collections on Lilium in Europe belong, according to the writer's interpretation, to the species formerly known as *Uromyces Lilii* (Link) Fckl. This species was first described by Strauss[1] under the name *Uredo aecidiiformis* on *Lilium candidum*. Although he used the generic term, Uredo, in designating the form, it is evident from the text that telia are described. For these reasons the species should take the name *Uromyces aecidiiformis* (Strauss). Regardless of the fact that the type of *Uromyces Miurae*[2] Sydow has not been examined, it is the writer's opinion that the American rust on Fritillaria is identical with it. Such disposition of a rust new to this country is not unusual when it is remembered that certain species of rust and other fungi have for a long time been known to be indigenous to Japan and eastern Asia as well as to the western and particularly to the northwestern coast of North America.

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[1] Ann. Wett. Ges. 2: 94. 1811.

[2] Ann. Myc. 11: 94. 1913.

The morphological differences of these three species are very clearly defined, and the species are easily separated, as shown in the analytical key which follows. Because of its close host relationship, *Uromyces Holwayi* Lagerh.[3] is included in the key. A description of this species, however, is omitted because of the fact that its life-cycle, which includes uredinia, precludes any possibility of its being confused with the species under discussion. No species of Uromyces, other than this one, has yet been reported on Lilium in North America.

KEY TO SPECIES ON LILIUM AND FRITILLARIA

Telia exclusively considered

Teliospore-wall moderately thick (2–3 μ), chestnut-brown.
  Teliospores globoid (exclusive of apiculus), 23–27 by 31–35 μ.. 1. *Uromyces aecidiiformis.*
  Teliospores ellipsoid, 18–25 by 29–39 μ..............2. *Uromyces Holwayi.*
Teliospore-wall moderately thin (1.5–2 μ), cinnamon-brown.
  Teliospores narrowly ellipsoid, 14–23 by 24–35 μ, inconspicuously verrucose in lines..................3. *Uromyces Miurae.*
  Teliospores ellipsoid to broadly so, 23–31 by 31–42 μ, delicately rugose..............................4. *Uromyces Fritillariae.*

1. **Uromyces aecidiiformis** (Strauss) comb. nov.

Uredo aecidiiformis Strauss, Ann. Wett. Ges. **2**: 94. 1811.
Caeoma Lilii Link in Willd. Sp. Pl. **6**^{2}: 8. 1825.
Caeoma aecidiiformis Schlecht. Linnaea **1**: 239. 1826.
Aecidium Meleagris Duby, Bot. Gall. **2**: 904. 1830.
Erysibe variolosa Wallr. Fl. Crypt. Germ. 195. 1833.
Erysibe rostellata var. *Lilii* Wallr. Fl. Crypt. Germ. 210. 1833.
Uromyces Liliacearum Unger, Einfl. Bodens 216. 1836.
Aecidium Liliacearum Unger, Einfl. Bodens 220. 1836.
Uredo Lilii Rab. Deutschl. Krypt. Fl. **1**: 12. 1844.
Uromyces Rabenhorstii Kunze, Rab. Fungi Eur. *1693a*. 1873.
Uromyces Lilii Kunze, Rab. Fungi Eur. *1693b*. 1873.

O. Pycnia amphigenous, rather numerous, among the aecia, small, 0.1–0.2 mm. across, punctate, conspicuous, subepidermal, honey-yellow, becoming darker later, chestnut-brown-colored ring encircling base, globoid in cross section, 160–190 μ high by 160–190 μ in diameter.

I. Aecia amphigenous, for the most part hypophyllous, also petiolicolous and caulicolous, gregarious in round or elongated groups of various sizes, up to 10 mm. in length, cupulate, low, 0.3–1 mm. in diameter; peridium white, turning to yellowish-brown, opening by a central pore, enlarging later, the margin erect or incurved slightly, erose; peridial cells oblong in cross section, 26–29 by 32–39 μ, abutted, the outer wall 7–13 μ thick, striate, the inner wall 9–12 μ in thickness, very finely and almost inconspicuously verrucose; aeciospores angularly globoid, 19–23 by 19–27 μ; wall pale yellow, 1.5–2.5 μ in thickness, finely and closely verrucose.

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[3] N. Amer. Fl. **7**: 242. 1907. (As *Nigredo Lilii* (G. W. Clinton) Arth.)

III. Telia amphigenous, numerous, scattered, elongated, 0.2–1.3 mm. in length, tardily naked, finally dehiscent by longitudinal slits in the epidermis, pulverulent, chestnut-brown, ruptured epidermis conspicuous; teliospores broadly ellipsoid to globoid (exclusive of apiculus), 23–27 by 31–35 μ (including apiculus); wall chestnut-brown, about 3 μ thick, a low hyaline apiculus at the apex, moderately rugose with longitudinal parallel ridges, sometimes appearing almost smooth when wet; pedicel very fragile, short, hyaline.

ON LILIACEAE: *Lilium bulbiferum* L., *L. candidum* L., *L. carniolicum* Bernh. and *L. croceum* Chaix. Throughout central Europe.

TYPE LOCALITY: Europe, on *Lilium candidum.*

EXSICCATI: Thüm. Myc. Univ. *1041;* Thüm. Fungi Austr. *848;* Rab. Fungi Eur. *1693;* Sydow, Ured. *1504;* Sydow, Myc. March. *3010;* Kunze, Fungi Sel. *35*.

Even in those collections showing teliospores only, *Uromyces aecidiiformis* is readily distinguished from *Uromyces Holwayi,* since the teliospores of the former are more nearly globoid and have slightly thicker walls than the latter (Fig. 1). However, the presence of aeciospores, which are quite different in the two species, enables one to separate them readily.

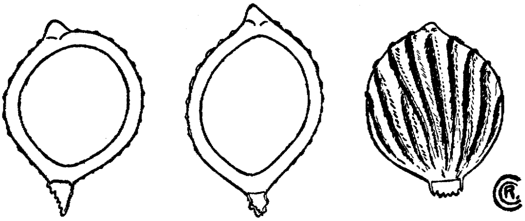

FIG. 1. Teliospores of *Uromyces aecidiiformis* showing optical sections and surface view. × 625.

3. **Uromyces Miurae** Sydow, Ann. Myc. **11**: 94. 1913.

O and I. Pycnia and aecia, unknown.

III. Telia amphigenous, petiolicolous, numerous, occasionally crowded in groups of two or three sori, round or broadly ellipsoid, 0.2–0.7 mm. across, tardily naked, finally dehiscent by longitudinal rents in the epidermis, pulvinate, becoming pulverulent, cinnamon-brown, ruptured epidermis conspicuous; teliospores rather narrowly and irregularly ellipsoid to terete, 14–23 by 24–35 μ, rounded or tapering at apex, usually tapering at base; wall golden to cinnamon-brown, of uniform thickness (1.5–2 μ), a low (1.5–3 μ), hyaline apiculus at apex, moderately and very inconspicuously verrucose, markings arranged to form longitudinal striations, appearing almost smooth when wet; pedicel very short, fragile, a sac-like swelling at point of attachment with spore.

ON LILIACEAE: *Fritillaria Kamtschatcensis* Ker. Alaska, British Columbia, Japan. *Fritillaria lanceolata* Pursh. Washington.

TYPE LOCALITY: Mt. Shirouma, prov. Shinano, Japan on *Fritillaria Kamtschatcensis.*

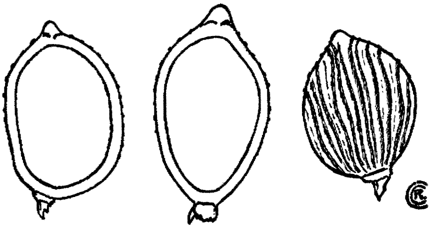

FIG. 2. Teliospores of *Uromyces infrequens* showing optical sections and surface view. × 625.

DISTRIBUTION: South-central and east-central Washington northwestward through Vancouver and Queen Charlotte islands to southeastern Alaska; also in central Japan.

EXSICCATI: Ellis & Ev. N. Am. Fungi *1863*.

It is impossible of course with only the telial stage present to assign this species with certainty to any genus in the classification based on the length of life-cycle, proposed by Arthur.[4] However, in spite of the lack of positive evidence which would indicate its proper taxonomic location, the writer is inclined to consider it an Opsis-form similar in life history to *Uromyces aecidiiformis* and *Uromyces Fritillariae.* Successful cultures or additional material bearing other spore stages will be necessary before the full life history is understood.

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[4] Eine auf die Struktur und Entwicklungsgeschichte begründete Klassifikation. Result. Sci. Congr. Bot. Vienne 331–348. 1906.

Morphologically this form is notably different from any species yet reported on any Liliaceous host either in North America or Europe and the addition of the North American material extends considerably the distribution of this distinctive species. The teliospores are more narrowly ellipsoid, have considerably thinner walls and are verrucose in longitudinal striations (Fig. 2). The teliospores of the other species discussed in this paper are distinctly rugose.

4. **Uromyces Fritillariae** (Schlechtd.) Thüm.; Voss, Oesterr. Bot. Zeits. **26**: 297. 1876

Caeoma Fritillariae Schlecht. Linnaea **1**: 240. 1826.

O. Pycnia amphigenous, rather numerous, scattered among the aecia, small, punctiform, conspicuous, subepidermal, honey-yellow becoming dark chestnut-brown, flattened globoid in cross section, 80–95 μ in width by 60–80 μ high; ostiolar filaments free.

I. Aecia amphigenous, caulicolous, petiolicolous, crowded in linear groups, cupulate, low, 0.3–1 mm. in diameter; peridium at first white, becoming yellowish-brown later, opening by a central pore after a longitudinal splitting of the epidermis has taken place, the margin incurved, erose; peridial cells oblong in cross section, 19–26 by 29–32 μ, abutted, the outer wall 9–13 μ thick, striate, the inner wall 9–12 μ thick, very finely verrucose; aeciospores angularly globoid to ellipsoid, 16–22 by 21–28 μ; wall yellow, 2–3 μ in thickness, very finely, closely and almost inconspicuously verrucose.

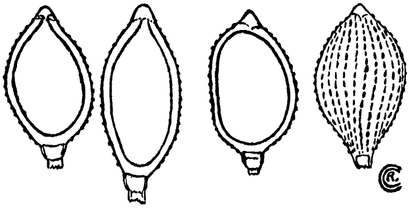

FIG. 3. Teliospores of *Uromyces Fritillariae* showing optical sections and surface view. × 625.

III. Telia amphigenous, caulicolous, petiolicolous, numerous, scattered, elliptical, rather small, 0.1–0.8 mm. in length, tardily naked, dehiscent by longitudinal slits in the epidermis, somewhat pulverulent, chestnut-brown, ruptured epidermis conspicuous; teliospores broadly ellipsoid to obovoid, 23–31 by 31–42 μ; wall golden- to cinnamon-brown, 1.5–2 μ thick, low (1.5–3 μ) hyaline apiculus at apex, rather delicately rugose in longitudinal striations; pedicel hyaline, short, fragile.

ON LILIACEAE: *Fritillaria Meleagris* L. in Europe.

TYPE LOCALITY: Southern Europe, on *Fritillaria Meleagris.*

EXSICCATI: Sydow Ured. *107;* Thüm. Myc. Univ. *553, 728;* Roum. Fungi Gall. *2922.*

This species differs in many respects from *Uromyces aecidiiformis* with which it has been included by European authors. The teliospores (Fig. 3) are larger, thinner walled and less prominently rugose than those on Lilium.

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